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Nitrate removal from landfill leachate in an anoxic rotating biological reactor

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Abstract

Nitrogen pollutants in wastewater are usually removed by biological methods such as autotrophic nitrification and heterotrophic denitrification.
The aim of this work was to study the denitrification process in an anoxic rotating biological contactor (RBC) for the final treatment of a landfill leachate with very high nitrate load.
The reactor was inoculated with acclimatized activated sludge and operated in a continuous mode with a hydraulic retention time of 10 h, using acetate as external carbon source. Two experiments were performed: one with a carbon to nitrogen ratio (C/N) of 2 and increasing nitrate load (from 100 to 560 mg $N\text{-}NO_3^-$/L); in the other the C/N ratio was varied while nitrate load was kept constant (220 mg $N\text{-}NO_3^-$/L).
In the first experiment the average removal efficiency of $N\text{-}NO_3^-$ was about 96 % and no nitrite accumulation was verified, highlighting the RBC high efficiency. Moreover, N_2 was the most abundant gaseous product indicating a complete denitrification process. An overall COD removal efficiency of 69% was attained. However, this does not comply with the maximum discharge limit (125 mg O_2/L).
To reduce COD in the effluent, in the second experiment lower C/N ratios (C/N=1.2 and 1.5) at constant nitrate load were tested. This change resulted in lower nitrate removal efficiencies while COD effluent values were still high. C/N was then increased again to the value used in the first experiment (C/N=2) and that caused an increase in nitrate removal. This puts to evidence that the organic matter present in the leachate is non-biodegradable. Thus the process depends deeply on the supplementary carbon added.
Based on the present results, it can be concluded that the tested anoxic RBC is a potential and convenient process for the removal of nitrate from landfill leachates with high nitrate loads.